

genus: *Agelacrinites*. The recognized species of this genus are enumerated in the annexed tabular view:—

Subkingdom **RADIATA**.

Class **ECHINODERMATA**. Order **THYROIDEA**.

Fam. **Agelacrinitidæ**.

Genus **AGELACRINITES**.

*Synopsis of Species.*

**A.—LOWER SILURIAN SPECIES.**

(Rays curved):—

1. *A. Buchianus*, E. Forbes.
2. *A. Cincinnatiensis*, Roemer.
3. *A. Dicksoni*, Billings.
4. *A. (Edrioaster) Bigsbyi*, Billings.

(Rays straight):—

5. *A. Bohemicus*, Roemer.
6. *A. Billingsii*, Chapman.

**B.—UPPER SILURIAN SPECIES.**

(Rays straight):—

7. *A. parasiticus*, Hall.

**C.—DEVONIAN SPECIES.**

(Rays curved):—

8. *A. Hamiltonensis*, Vanuxem.
9. *A. Rhenanus*, Roemer.

**D.—CARBONIFEROUS SPECIES.**

(Rays curved):—

10. *A. Kaskaskiensis*, Hall.

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**XXV.—On the Genera *Peltogaster* and *Liriope* of Rathke.**

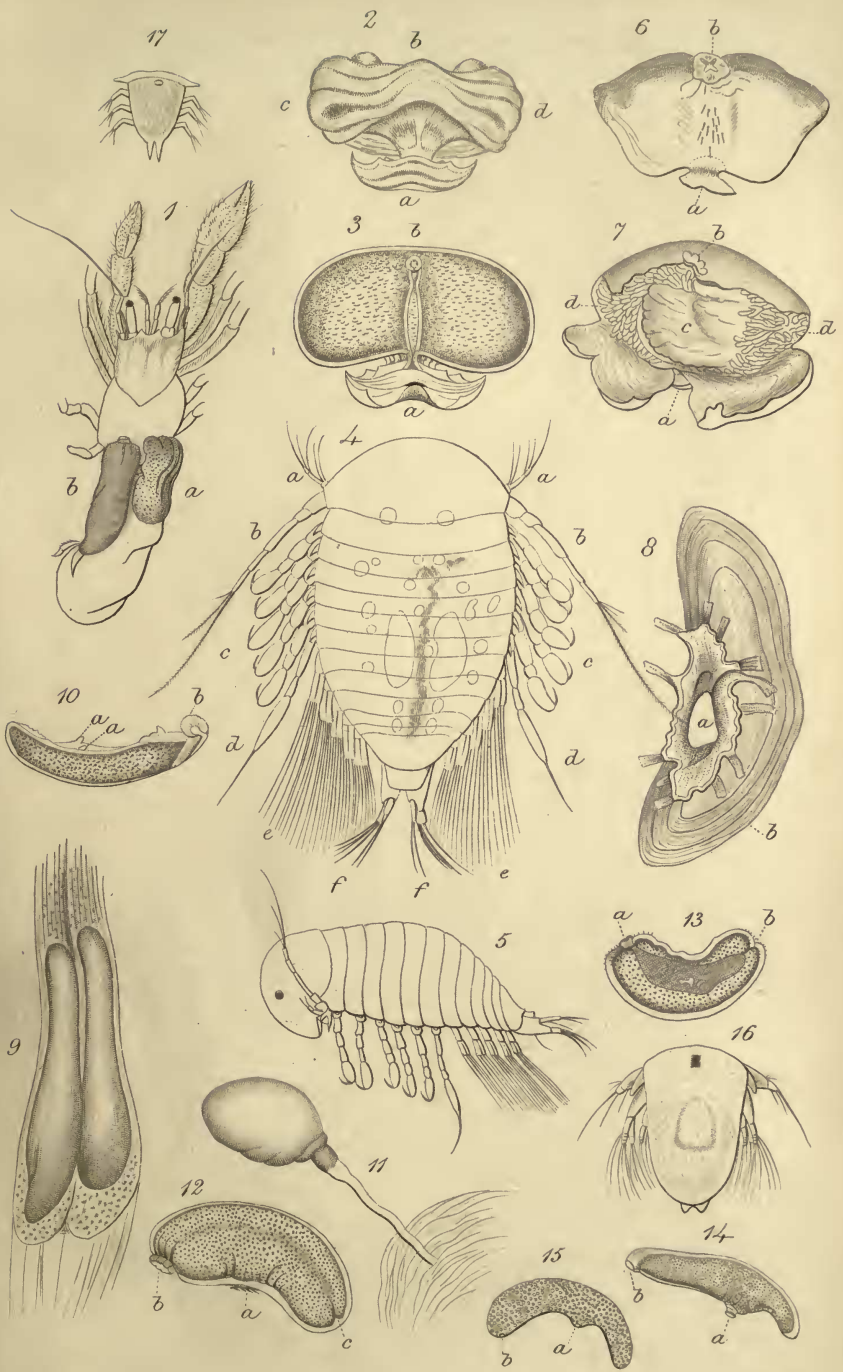
By **W. LILLJEBORG**.

[With a Plate.]

PROFESSOR LILLJEBORG of Upsal has published, in the 'Transactions of the Royal Academy of Sciences' of that place, a memoir containing detailed descriptions of the animals to which the above generic appellations were given by Rathke. As it forms an interesting supplement to the memoirs by Steenstrup and Leuckart which have already appeared in this Journal\*, we here give an abstract of its contents.

In the historical portion of his memoir, the author goes over the same ground as his predecessors; so that there is no occa-

\* See Ann. Nat. Hist. 2nd ser. vol. xvi. p. 153, and 3rd ser. vol. iv. p. 422.





sion to refer to it. Professor Lilljeborg considers that Rathke's *Peltogastri* belong to the group of Cirripedes, and admits the generic divisions established in them by Diesing.

Genus PACHYBDELLA, Diesing, Syst. Helm. i. p. 435.

Of this genus, which, as Leuckart has shown, is identical with *Sacculina* of Thompson, the author gives the following character:—

Animal e Crustaceorum classe et Cirripediorum subclasse, ectoparasitum sub abdomine Crustaceorum Decapodorum Brachyurorum degens.

Animal adultum crassum, sacciforme, transverse ellipticum, cute (pallio) lævi, molli, sed firma, corpus crassum, carnosum, intus glanduliforme et sine cavitate digestionis distincta, instar pallii circumdante, vestitum. Os in organo adfigendi, vel acetabulo, subinfundibuliformi, corneo perforatum, et in œsophagum transiens. Anus nullus? Ovaria externa numerosa, ramosa, cæciformia, circa corpus adfixa et membrana tenui involuta. Ovaria interna in corpore carnosio sita. Cavitas inter ovaria externa et pallium per foramen sat magnum, ori oppositum et plicis cutis circumdatum, aperta. Organa masculina ignota.

Pullus entomostraciformis, pullo Cirripediorum processibus ad latera partis anterioris corporis similis.

The form of the young proves that these animals belong to the Cirripedes. The mature animal is a sac without segments, eyes, or limbs (Pl. IV. fig. 6). This sac presents two prominent parts, of which the first, situated on the side by which the creature is attached to the animal on which it lives as a parasite, is a funnel-shaped organ of attachment (fig. 6 *a*), supported by a short neck and perforated in the middle by the mouth. At the opposite side there is a short tube, formed by folds of the skin, and surrounding an aperture of considerable size; the latter leads into the cavity containing the external ovaries, and appears to be intended to give exit to the young.

The œsophagus is small and short; in the individual examined by the author it was curved in a spiral form, and fixed to the lower side of a large fleshy part. The latter had a glandular appearance internally, and had no distinct digestive cavity; the author regards it as the transformed body probably occupied for the most part by the generative organs. The voluminous racemose interior ovaries were seen distinctly, but no male organs were observed. This body was continued to the superior aperture, where, however, it presented no anal opening, but its thick outer coat forms the large folds which surround that orifice. At one side the membrane enveloping the body appears to be more compact, and furnished with several distinct folds,

and here it is attached to the inner surface of the skin (*pallium*). Except at this point, the body is everywhere surrounded by the external ovaries, resembling ramose cæca (fig. 7 *d*). The structure of these resembles that of the external band-like ovaries described by Leuckart (Annals, ser. 3. vol. iv. p. 428, pl. 7. fig. 6) : according to Lilljeborg, they are contained in one, or perhaps two sacs formed of a delicate transparent membrane, which presents the appearance of an epithelium with irregular cells. The figure of the young animal given by Cavolini (copied in fig. 17) presents a closer resemblance to that of a newly-hatched larva of a Cirripede than that of *Peltogaster*, as observed by the author and Lindström.

Sp. 1. *Pachybdella Carcini*, Rathke. (Pl. IV. figs. 6 & 7.)

Animal supra et infra leviter sinuatum; partes laterales obtusæ; acetabulum rhomboideum, marginibus simplicibus, non multum expansis. Color rufescenti-flavidus. Latitudo circ. 17–20, et crassitudo 9–12 millim.

*Peltogaster Carcini*, H. Rathke, Beiträge zur Fauna Norwegens, Acta Leop. xx. p. 247, tab. 12. figs. 18, 19.

*Pachybdella Rathkei*, Diesing, Syst. Helm. i. p. 435.

It is found under the abdomen of *Carcinus Mænas*, attached over the intestinal canal, usually singly, sometimes two together. Also met with on *Portunus marmoreus*, and, according to Steenstrup, on *Portunus hirtellus* in the Mediterranean. Lovén has met with it on the abdomen of a *Hyas*.

The author adds that it is probable there may be several species of the genus, and, judging from Cavolini's figures, that he had more than one species under his eyes.

[As Leuckart has indicated (*l. c.* p. 424), the generic name *Pachybdella* must be changed to *Sacculina*, Thompson, and the species above described will stand as *Sacculina Carcini*, Thompson. We have also to add the species, *Sacculina inflata*, described by Leuckart.]

#### Genus PELTOGASTER, Rathke.

Reisebemerkungen, Neueste Schrift. der Naturforsch. Gesellsch. in Danzig, ii. p. 195; Beitr. z. Fauna Norw., Acta Leop. xx. p. 244.

From his observations on several new species of this genus, the author gives the following character for it:—

Animal e Crustaceorum classe et Cirripediorum subclasse, ectoparasiticum, in abdomine *Paguri* degens.

Animal adultum. Corpus sacciforme, elongatum, teretiusculum, vel depressiusculum, cute (pallio) plus vel minus pellucida sed firma obtectum, minime segmentatum, et partibus appendicularibus arti-

culatis destitutum. Os in organo adfigendi subinfundibuliformi vel acetabuliformi plus vel minus corneo, absque appendicibus buccalibus, in latere inferiore corporis situm. Ad extremitatem unam (anteriorē) corporis apertura, interdum magna, interdum parva, cavitatem generalem corporis internam aperiens adest\*. Nullum corpus internum carnosum adest nullusque ventriculus a cavitare corporis distinctus, quare hæc cavitatis, quæ intus, sub cute firma et transverse fibrosa, membrana tenui pellucida sat vero firma est vestita, et ad alimentum digerendum vel saltem adservandum, et ad ovaria complectanda servit. Genitalia bisexualia? Partes duæ subclavatæ vel sacculiformes (? testes vel vesiculæ seminales), pedunculo vel canali ad membranam internam cavitatis corporis sub ovariis adfixæ†. Ovaria duo, in principio in fundo cavitatis corporis supra et inter partes illas duas sacculiformes adfixa, juxta sese posita, extus sacciformia, intus acinosa, membrana cellulosa circumdata, et demum totam cavitatem corporis explentia, et inter se ita coalescentia, ut vix disjungi possint.

Pulli iisdem antecedentis similes, entomostraciformes, cum Cirripediorum pullis processibus lateralibus a parte anteriore et inferiore corporis exeuntibus congruentes, sed tamen etiam formam pullorum Lernæidarum referentes.

From their more simple internal structure, the deficiency of a fleshy internal body, and the sacciform ovaries which occupy the whole cavity, the author considers that these animals form not only a distinct genus, but even a distinct family. This presents some analogies with Darwin's order Apoda. The structure of the larva and of the mature animal, which is probably hermaphrodite, appears to prove that both *Peltogaster* and *Pachybdella* belong to the Cirripedia.

The form of the body in *Peltogaster* is cylindrical, sometimes a little flattened, and the aperture leading into the cavity of the body is placed at one of its extremities. These characters distinguish *Peltogaster* from *Pachybdella*. In other respects the two genera are similar. The body in *Peltogaster* is sacciform, enveloped in a soft and smooth, more or less compact and transparent skin, which has externally a very fine, transparent, structureless, chitinous epidermis, and under this a thicker and less transparent dermis, of fibrous structure, and furnished with transverse fibres. The thickness and opacity of this skin vary in different species, and even apparently in individuals of the same species, according as the internal parts are more or less developed. Within the dermis is a delicate transparent membrane without epithelium, slightly attached to the dermis by an

\* Rathke regarded this orifice as a mouth.

† Rathke, perhaps correctly, regards these as male sexual organs, and therefore believes the animals to be hermaphrodites, which is also the case in the Cirripede which approaches them most closely, although it is still very different—namely, Darwin's *Proteolepas*.

areolar tissue; this lines the internal cavity, and consequently embraces the ovaries. It is probably this membrane that Rathke regards as a stomach (*ventricule*); and when he found eggs in it, he was led to believe that the stomach of these animals also performed the function of a matrix.

The two parts which both Rathke and the author regard as male organs (*vesiculæ seminales*?) form, in *Peltogaster sulcatus*, opaque sacs filled with a cellular matter and furnished with a long neck (figs. 10 a & 11). This neck is fixed, beneath and to one side of the primary ovaries, to the inner surface of the lining membrane of the body-cavity. These parts are attached beneath the organ of adhesion, as mentioned by Rathke. Their cæcal extremities are directed forwards, as described by Rathke. As the author's specimens were preserved in spirit, he could not ascertain whether these sacs contained spermatozoids. He hints that they may be cement-glands, but, as they do not appear to be connected with the ovaries, from which, as asserted by Darwin, the cement-glands originate, and as he could not discover any connexion between them and the organ of adhesion, which ought to be formed by their secretion, he does not regard this function as probable. That *Peltogaster* possesses cement-glands is indicated by the structure of its organ of adhesion and the mode in which this organ is fixed to the skin of the abdomen of the *Pagurus*. On comparing the dilated disk of *Peltogaster Paguri* (fig. 8) with that of the basal membrane of *Coronula balænaris* figured by Darwin (Mon. Cirrip. ii. pl. 28. fig. 1 a), there appears to be a considerable resemblance between them. The margins of the organ of adhesion are more or less united to the skin of the *Pagurus*, so that, in separating them, fragments of the skin, or at least of the epidermis, remain attached to the margins of the organ\*.

The ovaries at first present the appearance of two sacs placed very close together; they are elongated, opaque, and a little thickened behind (Pl. IV. fig. 9). They are situated on the inferior wall of the body-cavity, immediately behind the organ of adhesion, upon the tegumentary membrane, which is much thicker in this spot. They are separately enveloped by a cellular membrane with different formative materials. Their walls are thick and opaque. The structure of the contents is acinose. When compressed and magnified 200 diameters, the ovules, with their germinal vesicle, are clearly seen enveloped in a tenacious matter, which is probably a future cement, as this, according to Darwin, issues in a similar form from the primitive ovaries of

\* According to Darwin, the cement of *Coronula balænaris* penetrates the epidermis of the Whales, and becomes confounded therewith in the way above described.

the Cirripedes. During the development of the ova the ovaries become enlarged, until at length they fill the whole cavity of the body, and at the same time they unite so closely, or even become so confounded, that it is sometimes impossible to discover their original limits. They then present the appearance of a single sac surrounded externally by the inner membrane of the body-cavity. When the skin is removed, the sacs of eggs appear as a single sac, the walls of which are formed by the membrane which lines the cavity of the body, but beneath this they are found to possess their own proper coats. These walls are less transparent and solid, cellular in structure, and contain formative substances, from which it follows that the sacs themselves act as matrices, and not the cavity of the body as supposed by Rathke. When the membrane enveloping the ovisacs bursts anteriorly, the young escape directly by the anterior aperture of the body-cavity. Probably the existence of the parent terminates with the accomplishment of its propagative destiny, as in other parasites; and thus we may explain the transformation of the ovaries into such enormous sacs. The author found two specimens of *Peltogaster sulcatus*, dead and completely empty, but still attached to the abdomen of *Pagurus chiracanthus*, Lillj. He has also found in the same matrix ova and newly-hatched young; it therefore appears that the development of the eggs does not take place simultaneously, although the difference is not great.

The organ of adhesion, being generally in the form of a funnel with a neck of greater or less length, is always of a harder texture than the surrounding skin, and more or less horny according to the age of the animal. Young individuals, in which the secretion of cement has been less, have the organ softer and lighter in colour; in older specimens it is hard and solid, at least in part, and its colour is then brown\*. It has always an aperture in the middle (fig. 8), through which the *Peltogaster* probably sucks its nourishment from its host. This orifice is continued through the neck of the organ of adhesion, and also through the epidermis and dermis. Rathke denies the existence of this aperture, believing that the orifice at one extremity leading into the cavity of the body was the mouth. But the form of the organ of adhesion and the mode in which it is attached to its host appear to prove that it is formed, as in the other Cirripedes, at least partially, by the secretion of cement†. As in the other Cirripedes, it appears that this organ is also formed by a transformation of the outer or second pair of antennæ, formed in the

\* The substance of which it is formed is probably chitinous.

† In a specimen of *P. Paguri*, the author once observed a portion of a canal attached by one of its extremities to the inner part of the epidermis; this might have been a cement-canal.



larvæ in the lateral apophyses of the anterior part of the body ; and as the mouth is situated in this organ, it appears that it also has been formed by the transformation of the tubular mouth of the larva. It presents different forms in the different species, and may furnish distinctive characters. Where it is fixed, the epidermis is always firmer and thicker, and it sometimes even extends over the epidermis like a shield (fig. 8 *b*). Sometimes there is only a ring of firmer tissue on the epidermis round its base. When the *Peltogastri* which have the organ of adhesion rounded, and not ramose, are separated from the skin of the *Pagurus*, the latter exhibits a round hole at the point where the organ of adhesion was fixed ; through this aperture they no doubt suck their nourishment.

The newly-hatched larva (fig. 16) is less elongated than the larvæ of other Cirripedes. The posterior part of the body is not pointed, but rounded and obtuse, as in the larvæ of the Lernæidæ and Copepoda. But the larva of *Peltogaster* differs from the latter by an apophysis projecting from each side of the front of the body, and issuing from the lower surface. In the very young larvæ this is attached to the body in such a manner that it is difficult to see it ; but as the second pair of antennæ are formed in these apophyses, and it is with these that the Cirripede afterwards adheres, it is evident that the apophyses are of the greatest importance, and their presence may be regarded as characterizing the animal. The larvæ of Cirripedes are distinguished from those of the Lernæidæ and Copepoda by the early presence of the first pair of antennæ not in the form of legs. The author has been unable to discover these antennæ in newly-hatched larvæ or in those still contained in the eggs\*.

No specimen of this genus has hitherto been discovered except upon species of the genus *Pagurus*. They are usually fixed upon the left side of the abdomen, in such a way that the aperture leading into the cavity of the body is turned towards the anterior part of the *Pagurus*, and consequently towards the aperture of the shell in which the *Pagurus* resides. This is probably to enable the young to escape as rapidly as possible. The

\* According to Claus (Archiv für Naturg. 1858, p. 1, and " Ueber den Bau und die Entwicklung parasitischer Crustaceen," Cassel, 1858, p. 5), the parts of the mouth in the Copepoda are formed from the third pair of feet of the larvæ, and the antennæ from the first and second pairs. As, according to Darwin, the feet in the larvæ of the Cirripedes have no significance as future antennæ, the appendages of the mouth of the Cirripedes, by analogy with the order of development of parts in the Copepoda, should be formed from the first pair of feet of their larvæ. But Darwin thinks that this pair of feet corresponds with the second pair of feet or cirri in the developed animals. There is here, at any rate, a great difference in the development of the Cirripedia and Entomostraca.

size of the parasites is in direct relation to that of the *Paguri*. On the smallest species of the genus *Pagurus* (*P. chiracanthus*), which is sometimes met with in shells as small as *Cerithium reticulatum*, the author has found specimens of *Peltogaster microstoma* only two millimetres in length. These contained no ova; but close to their organ of adhesion, which was but slightly developed, there were some long and fine filaments, apparently hollow canals, perhaps belonging to the cement-apparatus. Rathke also found similar filaments placed in two tubercles on the membrane of the "digestive sac," and probably in communication with the parts described above as male organs. Perhaps these, as well as the female organs, assist in the production of cement.

Besides Rathke's *P. Paguri*, the author describes two new species. The following table gives the distinctive characters of the three:—

<i>Peltogaster</i>	{	Organum	{	ramosum . . . . .	<i>Paguri</i> .	
		adfigendi,		{	magna,	<i>sulcatus</i> .
		sive			marginata . .	
acetabulum	}	simplex.	{	minima,	<i>microstoma</i> .	
	}	Apertura		neque		
		corporis		marginata . .		
		antica				

1. *Peltogaster Paguri*, Rathke. Pl. IV. fig. 12.

*Diagn.* Acetabulum in medio latere ventrali situm, ramosum.—  
Longit. maxim. circ. 16 millim.

*Peltogaster Paguri*, Rathke, Reisebemerungen, p. 105, tab. 6. figs. 12-16;  
Beitr. z. Fauna Norw. p. 245, tab. 12. fig. 17.

This is the largest known species. It is subject to variations both in its form and in the structure of the envelope of the body; even the structure of the organ of adhesion and of the aperture at the anterior extremity of the body varies to a certain extent. The form of the two individuals seen by the author is represented in Pl. IV. fig. 1 *b*. But these were small specimens, one measuring 8 and the other 4 millim.; the latter contained ova, the former did not. The form is more clumsy than in the other species, and nearly cylindrical, with the anterior part much thicker than the posterior. The body is much curved in a direction parallel to the curvature of the abdomen of the *Pagurus*; the skin is smooth, except a few longitudinal and transverse folds; it is generally thick and but slightly transparent, especi-

ally in young individuals. The epidermis, which is particularly transparent, appears to be generally raised a little above the dermal layer. On the lower surface is an elongated area in which the skin is less transparent, probably in consequence of the thickness and opacity of the inner skin. The four older and larger specimens lent to the author by Prof. Lovén were filled with ova, and had the posterior part of the body a little less narrowed than the other specimens. In three of them there were little spines at each extremity of the body (fig. 13); but these were wanting in the fourth and largest specimen, so that they cannot be regarded as characteristic of the species. In other respects the four specimens were exactly alike, and they were found upon the same species of *Pagurus* (*P. cuanensis*), and in the same locality. The organ of adhesion (fig. 8) is larger in this species than in the others, and also differs greatly in two respects: in the first place, it is fixed in this species upon a dilated corneous and elongated shield, having the two extremities obtuse and placed upon the middle of the lower part of the body; secondly, its margins are more dilated, and become dispersed in several branches, which are by degrees confounded with the external skin of the *Pagurus*. The shield extends only a little upon the lower surface of the body. In older individuals, the corneous matter of which this organ is formed is found to be more solid and darker in colour; the shield in these is also larger. In young individuals the central solid and dark part of the shield is surrounded by some clear concentric streaks, which, although they differ from the epidermis, have not yet acquired the solidity of the central part. The shield is therefore formed by an addition of new concentric layers of cement round the central layers, as well as by an addition of cement to the latter. There is also a small hollow neck between the shield and the acetabulum, of the same substance and colour as those parts (fig. 8 a). This neck is visible above the skin of the *Pagurus*.

The orifice at the anterior extremity of the body leading into the internal cavity is placed nearly in the middle of that extremity, which is the most obtuse. The size of this aperture and the number of folds of skin surrounding its tube are subject to variation. The same membrane which lines the cavity of the body also lines the interior of the tube.

The colour is variable: in some it is yellowish-green; in others, filled with well-developed eggs, reddish.

This species has been found on *Pagurus Bernhardus*, *P. pubescens*, *P. cuanensis* and *P. chircanthus*, on the coasts of Norway and Sweden. It usually occurs singly on the abdomen of the *Pagurus*.

2. *Peltogaster sulcatus*, n. sp. Pl. IV. fig. 14.

*Diagn.* Acetabulum pone medium situm, simplex, margine expanso, radiato. Infra inter acetabulum et aperturam corporis anteriorem magnam et marginatam bisulcatus.—Longit. circ. 7–8 mill.

This species is much smaller than the preceding, and has a more cylindrical form. It generally appears to be thicker at the part where the organ of adhesion is situated. The two extremities of the body are curved downwards, though not much. The part behind the organ of adhesion is shorter and more slender than the anterior part. There are some transverse folds in the vicinity of the organ of adhesion, and between this organ and the anterior aperture there are two longitudinal parallel furrows. Sometimes there are in this part several longitudinal folds in the skin, which is rather thick and scarcely transparent.

The organ of adhesion is well developed, though much smaller than that of the preceding species. The neck is very distinct, and the margins are turned outwards and present radiating furrows. In the middle there is an elevation, in which a small orifice (the mouth) is visible, surrounded by a brown horny ring. The rest, although apparently of more solid consistence than the skin, is of the same colour; there is no shield at its base, which is surrounded by a harder raised border of epidermis, and beyond this there is in the epidermis a streak of a more solid and more opaque substance.

The anterior part of the body presents a short tube, curved downwards and provided with longitudinal folds; this surrounds the large aperture of that part. Above this aperture the author has found a small empty space between the skin and the sac of eggs which fills the body. Specimens preserved in spirits are of a yellowish-white colour.

This species has been found upon *Pagurus cuanensis* and *P. chiracanthus*, on the coasts of Norway. Dr. G. Lindström met with as many as seven upon the same individual of *P. cuanensis*. The anterior part of the body is usually directed a little to the right above the abdomen of the *Pagurus*.

3. *Peltogaster microstoma*, n. sp. Pl. IV. fig. 15.

*Diagn.* Acetabulum pone medium situm, minimum, margine vix expanso et radiato. Apertura anterior minima, vix visibilis, neque marginata.—Long. 5–6 mill.

This species is smaller than the preceding, and is distinguished from both the others by the smallness of the organ of adhesion and of the anterior aperture. Its form is very variable: it is sometimes cylindrical (fig. 15), sometimes much flattened, probably owing to the varying pressure of the surrounding shell.